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Description

The invention relates to medical guidewires, e.g., for navigation of narrow passages of a body. A physician introduces the distal end of the guidewire into the body, e.g., via a puncture opening, and, observing the progress of the guidewire via radioscope, attempts to manipulate the flexible tip of the guidewire, e.g., by rotation of the proximal end of the guidewire outside the body, to enter desired passageways and follows their convolutions to a treatment site. A catheter or other medical device may then be advanced over the guidewire to the site.

The U.S. Patent 3,749,086 shows a guidewire with an elongated helically wound spring body having a tip portion of relatively greater flexibility. The guidewire has a core with a distal end portion disposed in the dip region and spaced proximally from a round tip element defining a distal end of the guidewire. A coil is joined to the body portion of the core, and the safety wire is secured to the core and joined to the round tip. The increased flexibility at the distal end makes it easier to follow the desired passages in the body.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a guidewire which not only has a greater flexibility as at the distal tip region but also reliably transmits torque to the distal tip of the guidewire and still has a high degree of flexibility.

This object is achieved by the features:
the core has a body portions of a first diameter, a distal portion of a relatively smaller diameter, and a generally flat distal end portion; the first coil terminates proximal of the end portion of the core; the guidewire has a relatively more flexible second coil having a proximal end joined to said first coil and has a distal end joined to the round tip element; said safety wire has a generally flat distal end portion within said second coil; and a transition wire having a generally flat distal end portion is disposed to terminate within said second coil overlapping the distal end of the flat portion of the core and the proximal end of the flat portion of the safety wire.

Preferred embodiments of this aspect of the invention have one or more of the following features. The generally flat distal end portions of the core, safety wire and transition wire are of predetermined axial extent, and the generally flat distal end portion of the transition wire is disposed to span a gap between the proximal end of the safety wire end portion and the distal end of the core end portion. At least one of the safety wire and the transition wire is a flat ribbon wire. At least one of the safety wire, the transition wire, the second coil and the round tip element are of radioopaque material, e.g., comprising platinum. The first coil in a first region preceding the second coil has a first outer diameter and in a second region distal to the first region the first coil has a second, relatively smaller outer diameter, and the second coil, in a proximal region adjacent the first coil, has an outer diameter substantially equal to the first outer diameter of the first coil and an inner diameter substantially equal to the second outer diameter of the first coil, and the proximal region of the second coil is disposed about the second, smaller diameter region of the first coil. Preferably the diameter of the first coil in the first region is substantially uniform, and the diameter of the first coil in the second region is substantially uniform, and the first region lies immediately adjacent the second region. Also, the relatively smaller second diameter of the second region of the first coil is formed by removal of coil wire material from the exterior of the coil, preferably by grinding. The first coil and the second coil are joined in the proximal region of the second coil. Adjacent windings of the first coil in the region proximal of joining to the second coil are relatively more spaced than adjacent windings of other, more proximal regions of the first coil. The first coil terminates distal of the proximal end of the core and the guidewire further comprises a sleeve of polymeric material, preferably polytetrafluorethylene (PTFE), disposed about the core. The sleeve terminates distally adjacent the proximal end of the first coil and the outer diameter of the first coil adjacent the sleeve is equal to or greater than the outer diameter of the adjacent sleeve.

According to another aspect of the invention, a medical guidewire comprises, in sequence, a first coil and a relatively more flexible second coil, the first coil in a first region preceding the second coil having a first outer diameter and in a second region distal the first region the first coil having a second, relatively smaller outer diameter, and the second coil, in a proximal region adjacent the first coil, having an outer diameter substantially equal to the first outer diameter of the first coil and an inner diameter substantially equal to the second outer diameter of the first coil, and the proximal region of the second coil is disposed about the second, smaller diameter region of the first coil.

In preferred embodiments of this aspect of the invention, the diameter of the first coil in the first region is substantially uniform, and the diameter of the first coil in the second region is substantially uniform, and the first region lies immediately adjacent the second region; and the relatively smaller second diameter of the second region of the first coil is formed by removal of coil wire material from

the exterior of the coil, e.g., by grinding.

Further preferred embodiments of this aspect of the invention may include one or more of the following features. The first coil is formed of round wire, and the second coil may be as well. The difference between the first outer diameter and the second outer diameter is less than or equal to one-half the diameter of the round wire. The first and second coil are joined in the proximal region of the second coil. Adjacent windings of the first coil in the region proximal of joining to the second coil are relatively more spaced than adjacent windings of other more proximal regions of the first coil. The first coil and/or the second coil have outer portions of tapering diameter.

Attributes sought by physicians employing guidewires include high torque response of the distal tip within the body to rotation of the portion outside the body; stiffness over much of the length for transmission of axial pressure; a flexible tip to facilitate manipulation into side branches and through convuluted passages and also to avoid patient trauma; and also a radioopaque tip region for clear viewing. The guidewire of the invention features these attributes and further provides a relatively smooth transition from the relative stiff proximal portion of the guidewire to the flexible distal tip.

These and other features and advantages of the invention will be apparent from the following description of a presently preferred embodiment, and from the claims.

PREFERRED EMBODIMENT

We first briefly describe the drawings.

Fig. 1 is a side view partially in section of a medical guidewire of the invention;

Fig. 2 is a top plan view of the core and sleeve of the guidewire of Fig. 1;

Fig. 3 is a perspective view partially in section of the distal tip region of the guidewire of Fig. 1;

Fig. 4 is a side section view of the coil-to-coil joint; and

Fig. 5 is a somewhat diagrammatic representation of the guidewire flexed to show the smooth transition of flexibility.

Referring to Figs. 1 and 2, a guidewire 10 of the invention has an elongated core 12, a first coil 14 joined at its proximal end 16 to the core, and a second coil 18 joined to the distal end of the first coil at 20 and extending distally to a distal round end tip element 22, e.g., a weldment.

Referring to Fig. 3, disposed within the distal portion of the first coil and extending along within the second coil, along the distal portion of the core, are safety wire 24 and transition wire 26, e.g., platinum wire, having a diameter of 0,076 mm (0.003 inch), or a cross section of 0,051 mm (.002 inch) by 0,127mm (.005 inch). The safety and transition wires terminate distally in generally flat end portions 28, 30, respectively, e.g., about 10 mm long by 0,127 mm (0.005 inch) wide by 0,03 mm (0.0012 inch) thick, formed by flattening the ends of the wires. The distal end of the safety wire 24 extends and is joined, e.g., by soldering (or brazing, spot welding, bonding or T.I.G. (tungsten inert gas) welding), to the distal round end tip element 22. The transition wire 26 terminates distally within the second coil, spaced about 7 mm from tip element 22. In the preferred embodiment, the transition wire 26 and safety wire 24 are formed of a single wire, and may be joined proximally at loop 25 (Fig. 3). Both wires are attached to the core at the loop, about 6 inches from the distal tip, e.g., by soldering or the like.

The core 12, e.g., about 143 cms long, is formed, e.g., of stainless steel and has a body portion 32, e.g., 0,51 mm (0.020 inch) diameter, and a tip portion 34, e.g., 0,076 mm (0.003 inch) diameter and 8.0 cm long, with a smoothly tapering portion 36, e.g., about 5.5 cm long, therebetween. The body 32 of the core forms generally the body of the guidewire, while the tapering and tip portions 36, 34, in combination with the other components described define a distal tip region of relatively greater flexibility, the guidewire smoothly becoming more flexible in the direction of the tip. The tip portion 34 of the core terminates distally in a flat distal end 38, e.g. about 10 mm long by 0,127 mm (0.005 inch) wide by 0,03 mm (0.0012 inch) thick, formed by flattening the end of the core wire. The core extends distally within the second coil and terminates (Fig. 3) at a position spaced, e.g., about 10 mm from tip element 22.

As shown, the core wire is positioned to leave a gap 40 between the end portions 28, 38 of the safety wire 24 and the core 12, and the end portion 30 of the transition wire is disposed to bridge the gap. The result is a smooth transition of flexibility to the tip, as described more fully below with reference to Fig. 5.

Disposed about the proximal portion of the body of the core is a sleeve 42, e.g., polytetrafluorethylene (PTFE) heat shrunk tightly about the core 12. Typically, prior to heat shrinking, the sleeve has a 1,52 mm (0.060 inch) outer diameter and 0,076 mm (0.003 inch) wall. The sleeve is diposed in position about the core and heated to 480 °C (800 °F), e.g., with a hot air blower or in an oven or by other suitable means, to shrink the sleeve to engage tightly about the core.

The first coil 14, e.g., made from stainless steel wire having a diameter of 0,178 mm (0.007 inch) formed into a pre-tension coil, has a proximal portion 44 with an outer diameter of about 0,88 mm

(0.035 inch) and tapers in tie region 46, corresponding generally to the tapering portion 36 of the core 12, to a distal portion 48 having an outer diameter of 0,635 mm (0.025 inch). The coil 14 is joined to the core 12, e.g., by soldering or the like, at 16, adjacent the distal end of the sleeve 42. (The outer diameter of the sleeve is equal to or preferably less than the outer diameter of the coil, as shown.)

The second coil 18 is formed of a radioopaque material, e.g., platinum, for enhanced visibility within the body via radioscope. The coil 18 is a 0,076 mm (0.003 inch) diameter wire formed into a coil having an outer diameter at its proximal end (region 20) corresponding to the outer diameter of the adjacent end of first coil 14, e.g., 0,635 mm (0.025 inch), and a consequent inner diameter of 0,483 mm (0.019 inch). The second coil tapers (region 21) to a flexible proximal portion 19 about 30 mm long with an outer diameter of about 0,457 mm (0.018 inch).

Referring to Fig. 4, the first coil 14 and second coil 18 are joined by removing wire material from the outer diameter of the first coil, e.g., by grinding, to a depth substantially equal to the diameter or thickness of the wire forming the second coil. Preferably, the wires of the first and second coils are sized so no more than one half of the diameter of the first coil must be removed. As a result, removal of material from the exterior of the first coil provides a smooth flat surface for joining of the second coil and the windings of the first coil remain engaged under pretension. (Removal of more than one-half of the diameter will result in a soft, loose coil.) The proximal end of the second coil is disposed over the distal end 49 of the first coil in the region 20 and the two are joined, e.g., by solder 46 or the like. To further enhance the smoothness of the transition from the relatively stiff first coil 14 to the more flexible second coil 18 adjacent windings 51 of the first coil (region 53), proximal of the joint (region 20), are tweeked, i.e., spaced apart, to relieve the pretension set in forming and the windings are permanently deformed in the spaced condition, rendering the first coil relatively more flexible in the region approaching the joint and the considerably more flexible second coil.

The combination of structural features described above, including, without limitation, the materials and the relationships of dimension and construction, results in a guidewire that provides a high degree of torque, i.e., approaching 1-to-1, between rotation of the proximal end and response of the distal tip, and further results in a guidewire having relatively smooth and gradual transition from the guidewire body to the relatively more flexible distal tip. Referring to Fig. 5, the guidewire 10 of the invention increased in flexibility in the distal tip region toward the tip.

Other embodiments are within the following claims. For example, referring to Fig. 4, the safety wire 24' and transition wire 26' may be one or a pair of flat ribbon wires. The safety and transition wires may be severed at 25 to lie side-by-side prior to being secured to the core.

Claims

1. A medical guidewire (10) having an elongated body that has a degree of flexibility and a distal tip region of relatively greater flexibility, said guidewire comprising
a core (12) having a distal end portion, said end portion disposed in said tip region and spaced proximally from a round tip element (22) that defines a distal end of said guidewire,
a first coil (14) joined to the body portion of said core and extending along said core to a termination point in said distal tip region, and
a safety wire (24) secured to said core joined to said round tip element,
characterized in
that the core has a body portion (32) of a first diameter, a distal portion (34) of a relatively smaller diameter, and a generally flat distal end portion (38);
the first coil (14) terminates proximal of the end portion of the core;
the guidewire has a relatively more flexible second coil (18) having a proximal end joined to said first
coil (14) and has a distal end joined (20) to the round tip element;
said safety wire (24) has a generally flat distal end portion (28) within said second coil; and
a transition wire secured to said core and (26) having a generally flat distal end portion (30) is disposed to terminate within said second coil, said flat distal end portion overlapping the distal end of the flat portion (30) of the core (12) and the proximal end of the flat portion (28) of the safety wire (24).

2. The medical guidewire of claim 1 wherein the generally flat distal end portions of the core, safety wire and transition wire are of predetermined axial extent, and the generally flat distal end portion (30) of said transition wire is disposed to span a gap (40) between a proximal end of the safety wire (24) generally flat distal end portion and a distal end of the core (12) generally flat distal end portion.

3. The medical guidewire of claim 1 wherein at least one of said safety wire and said transition wire is a flat ribbon wire.

4. The medical guidewire of claim 1 wherein at least one of said safety wire, said transition wire, said second coil and said round tip element are of radioopaque material.

5. The medical guidewire of claim 1 wherein said radioopaque material comprises platinum.

6. The medical guidewire of claim 1 wherein said first coil (14) in a first region (53) preceding said second coil has a first outer diameter and in a second region (49) distal said first region said first coil has a second relatively smaller outer diameter, and

said second coil (18), in a proximal region adjacent said first coil, has an outer diameter substantially equal to the first outer diameter of said first coil and an inner diameter substantially equal to the second outer diameter of said first coil, and the proximal region of said second coil is disposed about the second, smaller diameter region of said first coil.

7. The medical guidewire of claim 6 wherein the diameter of said first coil (14) in said first region is substantially uniform, and the diameter of said first coil in said second region is substantially uniform, and said first region lies immediately adjacent said second region.

8. The medical guidewire of claim 6 wherein the relatively smaller second diameter of the second region of said first coil is formed by removal of coil wire material from the exterior of said coil.

9. The medical guidewire of claim 6 wherein said first coil and said second coil are joined (20) in the proximal region of said second coil.

10. The medical guidewire of claim 1 or 6 wherein adjacent windings of said first coil (14) in the region proximal of joining to said second coil (18) are relatively more spaced than adjacent windings of other, more proximal regions of said first coil.

11. The medical guidewire of claim 1 wherein said first coil terminates distal (16) of a proximal end of said core and said guidewire further comprises a sleeve (42) of polymeric material disposed about said core.

12. The medical guidewire of claim 11 wherein the material of said sleeve is polytetrafluorethylene (PTFE).

13. The medical guidewire of claim 11 wherein the sleeve (42) terminates distally adjacent a proximal end (16) of said first coil (14) and the outer diameter of said first coil adjacent said sleeve is equal to or greater than the outer diameter of the adjacent sleeve.

14. The medical guidewire of claim 1 comprising, in sequence, a first coil (14) and a relatively more flexible second coil (18),

said first coil in a first region (53) preceding said second coil having a first outer diameter and in a second region (49) distal said first region said first coil having a second, relatively smaller outer diameter, and

said second coil, in a proximal region (49) adjacent said first coil, having an outer diameter substantially equal to the first outer diameter of said first coil and an inner diameter substantially equal to the second outer diameter of said first coil, and the proximal region of said second coil is disposed about the second, smaller diameter region of said first coil.

15. The medical guidewire of claim 14 wherein the diameter of said first coil (14) in said first region (53) is substantially uniform, and the diameter of said first coil in said second region (49) is substantially uniform, and said first region lies immediately adjacent said second region.

16. The medical guidewire of claim 14 wherein the relatively smaller second diameter of the second region of said first coil is formed by removal of coil wire material from the exterior of said coil.

17. The medical guidewire of claim 14 wherein

said first coil (14) being formed of round wire, said first coil in a first region preceding said second coil (18) having a substantially uniform first outer diameter and in a second region distal said first region said first coil having a second, relatively smaller, substantially uniform outer diameter formed by removal of coil wire material from the exterior of said coil, said first region lying immediately adjacent said second region, the difference between said first outer diameter and said second outer diameter being less than or equal to one-half the diameter of said round wire, and

said second coil, (18) in a proximal region adjacent said first coil, having an outer diameter substantially equal to the first outer diameter of said first coil (14) and an inner diameter substantially equal to the second outer diameter of said first coil, and the proximal region

of said second coil being disposed about the second, smaller diameter region of said first coil.

18. The medical guidewire of claim 17 wherein the wire of said second coil is round.

19. The medical guidewire of claim 14 or 17 wherein said first coil and said second coil are joined (20) in the proximal region of said second coil.

20. The medical guidewire of claim 14 or 17 wherein adjacent windings of said first coil (14) in the region proximal of joining to said second coil (18) are relatively more spaced than adjacent windings of other, more proximal regions of said first coil.

21. The medical guidewire of claim 1, 6, 14 or 17 wherein said first coil (14) has an outer portion of tapering diameter.

22. The medical guidewire of claim 1, 6, 14 or 17 wherein said second coil (18) has an outer portion of tapering diameter.

Patentansprüche

1. Medizinischer Führungsdraht (10) mit einem langgestreckten Körper, der einen Grad von Flexibilität aufweist und einer entfernten Spitzenregion verhältnismäßig größerer Flexibilität, wobei der Führungsdraht umfaßt
einen Kern (12) mit einem fernen Endabschnitt, der in einem geringen Abstand von einem abgerundeten Spitzenelement (22) angeordnet ist, das ein fernes Ende des Führungsdrahtes definiert,
einer ersten Spule (14), die mit dem Körperabschnitt des Kerns verbunden ist und sich entlang des Kerns bis zu einem Endpunkt in der fernen Spitzenregion erstreckt, und
einem Sicherheitsdraht (24), der an dem mit dem abgerundeten Spitzenelement verbundenen Kern befestigt ist,
dadurch gekenzeichnet, daß
der Kern einen Körperabschnitt (32) mit einem ersten Durchmesser, einen fernen Abschnitt (34) von relativ kleinerem Durchmesser und einen im allgemeinen flachen fernen Endabschnitt (38) aufweist;
die erste Spule (14) nahe dem Endabschnitt des Kerns endet;
der Führungsdraht eine relativ flexiblere zweite Spule (18) aufweist, die ein nahes Ende hat, das mit der ersten Spule (14) verbunden ist, und ein fernes Ende, das mit dem abgerundeten Spitzenelement verbunden ist (20);
wobei der Sicherheitsdraht (24) einen im allgemeinen flachen fernen Endabschnitt (28) innerhalb der zweiten Spule aufweist, und
daß ein Übergangsdraht (26), der an dem Kern befestigt ist und einen im allgemeinen flachen fernen Endabschnitt (30) aufweist, so angeordnet ist, daß er innerhalb der zweiten Spule endet, wobei der flache ferne Endabschnitt das ferne Ende des flachen Abschnittes (30) des Kerns (12) und das nahe Ende des flachen Abschnittes (28) des Sicherheitsdrahtes (24) überlappt.

2. Medizinischer Führungsdraht nach Anspruch 1, wobei die im allgemeinen flachen fernen Endabschnitte des Kerns, des Sicherheitsdrahtes und des Übergangsdrahtes von vorbestimmter axialer Ausdehnung sind, und der im allgemeinen flache ferne Endabschnitt (30) des Übergangsdrahtes so angeordnet ist, daß er einen Spalt (40) zwischen dem nahen Ende des im allgemeinen flachen fernen Endabschnittes des Sicherheitsdrahtes (24) und ein fernes Ende des im allgemeinen flachen fernen Endabschnittes des Kerns (12) überspannt.

3. Medizinischer Führungsdraht nach Anspruch 1, wobei der Sicherheitsdraht und/oder der Übergangsdraht ein flacher Banddraht ist.

4. Medizinischer Führungsdraht nach Anspruch 1, wobei wenigstens eines der Elemente Sicherheitsdraht, Übergangsdraht, zweite Spule und abgerundetes Spitzenelement aus strahlenundurchlässigem Material ist.

5. Medizinischer Führungsdraht nach Anspruch 1, wobei das strahlungsundurchlässige Material Platin enthält.

6. Medizinischer Führungsdraht nach Anspruch 1, wobei die erste Spule (14) in einem ersten Bereich (53) vor der zweiten Spule einen ersten äußeren Durchmesser und in einem zweiten Bereich (49) entfernt von dem ersten Bereich einen zweiten relativ kleineren äußeren Durchmesser aufweist, und daß die zweite Spule (18), in einem nahen Bereich benachbart der ersten Spule, einen äußeren Durchmesser aufweist, der im wesentlichen gleich dem ersten Außendurchmesser der ersten Spule ist, und einen inneren Durchmesser, der im wesentlichen gleich dem zweiten Außendurchmesser der ersten Spule ist, und daß der Nahbereich der zweiten Spule über dem zweiten Bereich Kleineren Durchmessers der ersten Spule angeordnet ist.

7. Medizinischer Führungsdraht nach Anspruch 6, wobei der Durchmesser der ersten Spule (14) in dem ersten Bereich im wesentlichen gleichförmig ist, und der Durchmesser der ersten Spule in dem zweiten Bereich im wesentlichen gleichförmig ist, und der erste Bereich unmittelbar benachbart dem zweiten Bereich liegt.

8. Medizinischer Führungsdraht nach Anspruch 6, wobei der relativ kleinere zweite Durchmesser des zweiten Bereichs der ersten Spule gebildet wird durch Entfernung von Spulendrahtmaterial von dem Äußeren der Spule.

9. Medizinischer Führungsdraht nach Anspruch 6, wobei die erste Spule und die zweite Spule im Nahbereich der zweiten Spule verbunden sind (20).

10. Medizinischer Führungsdraht nach Anspruch 1 oder 6, wobei benachbarte Windungen der ersten Spule (14) in dem Bereich nahe der Verbindung mit der zweiten Spule (18) relativ größeren Abstand haben als benachbarte Windungen anderer, näherer Bereiche der ersten Spule.

11. Medizinischer Führungsdraht nach Anspruch 1, wobei die erste Spule fern von einem nahen Ende des Kerns endet und der Führungsdraht ferner eine Hülle (42) aus Polymermaterial enthält, die über dem Kern angeordnet ist.

12. Medizinischer Führungsdraht nach Anspruch 11, wobei das Material der Hülle Polytetrafluoräthylen (PTFE) ist.

13. Medizinischer Führungsdraht nach Anspruch 11, wobei die Hülle (42) fern benachbart einem nahen Ende (16) der ersten Spule (14) endet und der äußere Durchmesser der ersten Spule benachbart der Hülle gleich oder größer als der äußere Durchmesser der benachbarten Hülle ist.

14. Medizinischer Führungsdraht nach Anspruch 1, enthaltend aufeinanderfolgend eine erste Spule (14) und eine relativ flexiblere zweite Spule (18), wobei die erste Spule in einem ersten Bereich (53) vor der zweiten Spule einen ersten äußeren Durchmesser und in einem zweiten Bereich (49) entfernt von dem ersten Bereich einen zweiten, relativ kleineren äußeren Durchmesser hat, und wobei die zweite Spule, in einem fernen Bereich (49) benachbart der ersten Spule, einen äußeren Durchmesser hat, der im wesentlichen gleich dem ersten äußeren Durchmesser der ersten Spule ist, und einen inneren Durchmesser, der im wesentlichen gleich dem zweiten äußeren Durchmesser der ersten Spule ist, und der ferne Bereich der zweiten Spule über dem zweiten Bereich kleineren Durchmessers der ersten Spule angeordnet ist.

15. Medizinischer Führungsdraht nach Anspruch 14, wobei der Durchmesser der ersten Spule (14) in dem ersten Bereich (53) im wesentlichen gleichförmig ist, und der Durchmesser der ersten Spule in dem zweiten Bereich (49) im wesentlichen gleichförmig ist, und der erste Bereich unmittelbar benachbart zu dem zweiten Bereich liegt.

16. Medizinischer Führungsdraht nach Anspruch 14, wobei der relativ kleinere zweite Durchmesser des zweiten Bereiches der ersten Spule gebildet ist durch Entfernung von Spulendrahtmaterial von dem Äußeren der Spule.

17. Medizinischer Führungsdraht nach Anspruch 14, wobei die erste Spule (14) aus rundem Draht gebildet ist, wobei die erste Spule in einem ersten Bereich vor der zweiten Spule (18) einen im wesentlichen gleichförmigen ersten äußeren Durchmesser und in einem zweiten Bereich, entfernt von dem ersten Bereich, einen zweiten relativ kleineren, im wesentlichen gleichförmigen äußeren Durchmesser aufweist, gebildet durch Entfernung von Spulendrahtmaterial vom Äußeren der Spule, wobei der erste Bereich unmittelbar benachbart dem zweiten Bereich liegt, und die Differenz zwischen dem ersten äußeren Durchmesser und dem zweiten äußeren Durchmesser kleiner oder gleich der Hälfte des Durchmessers des runden Drahtes ist, und die zweite Spule (18) in einem entfernten Bereich benachbart der ersten Spule einen äußeren Durchmesser aufweist, der im wesentlichen gleich dem ersten äußeren Durchmesser der ersten Spule (14) ist, und einen inneren Durchmesser, der im wesentlichen gleich dem zweiten äußeren Durchmesser der ersten Spule ist, wobei der Nahbereich der zweiten Spule über dem zweiten Bereich kleineren Durchmessers der ersten Spule angeordnet ist.

18. Medizinischer Führungsdraht nach Anspruch 17, wobei der Draht der zweiten Spule rund ist.

19. Medizinischer Führungsdraht nach Anspruch 14 oder 17, wobei die erste Spule und die zweite Spule in dem Nahbereich der zweiten Spule miteinander verbunden sind (20).

20. Medizinischer Führungsdraht nach Anspruch 14 oder 17, wobei benachbarte Windungen der ersten Spule (14) in dem Bereich nahe der Verbindung mit der zweiten Spule (18) relativ größeren Abstand haben als benachbarte Windungen anderer näherer Bereiche der ersten Spule.

21. Medizinischer Führungsdraht nach Anspruch 1, 6, 14 oder 17, wobei die erste Spule (14) einen äußeren Abschnitt mit konisch zulaufendem Durchmesser hat.

22. Medizinischer Führungsdraht nach Anspruch 1, 6, 14 oder 17, wobei die zweite Spule (18) einen äußeren Abschnitt mit konisch zulaufendem Durchmesser hat.

Revendications

1. Câble médical de guidage (10) comportant un corps allongé qui a un certain degré de souplesse et une zone formant extrémité distale de souplesse relativement plus grande, ledit câble de guidage comportant

un noyau (12) ayant une partie d'extrémité distale, ladite partie d'extrémité étant agencée dans ladite zone d'extrémité et étant écartée dans la direction proximale à partir d'un élément (22) formant bout arrondi qui définit l'extrémité distale dudit câble de guidage,

un premier enroulement (14) relié à la partie formant corps dudit noyau et s'étendant le long dudit noyau jusqu'à un point d'arrêt situé dans ladite zone d'extrémité distale, et

un fil de sécurité (24) fixé audit noyau, relié audit élément formant bout arrondi,

caractérisé en ce que

le noyau a une partie (32) formant corps ayant un premier diamètre, une partie distale (34) ayant un diamètre relativement plus petit, et une partie (38) formant extrémité distale de manière générale plate,

le premier enroulement (14) se termine à proximité de la partie d'extrémité du noyau,

le câble de guidage a un second enroulement (18) relativement plus souple ayant une extrémité proximale reliée audit premier enroulement (14) et une extrémité distale reliée (en 20) à l'élément formant bout arrondi,

ledit fil de sécurité (24) a une partie (28) formant extrémité distale de manière générale plate située à l'intérieur dudit second enroulement, et

un fil de transition (26) fixé audit noyau et ayant une partie (30) formant extrémité distale de manière générale plate et agencée pour se terminer à l'intérieur dudit second enroulement, ladite partie formant extrémité distale plate recouvrant l'extrémité distale de la partie plate (38) du noyau (12) et l'extrémité proximale de la partie plate (28) du fil de sécurité (24).

2. Câble de guidage médical selon la revendication 1, dans lequel les parties formant extrémité distale de manière générale plate du noyau, le fil de sécurité et le fil de transition ont une amplitude axiale prédéterminée, et la partie (30) formant extrémité distale de manière générale plate dudit fil de transition est agencée pour franchir un espace (40) situé entre l'extrémité proximale de la partie formant extrémité distale de manière générale plate du fil de sécurité (24) et une extrémité distale de la partie formant extrémité distale de manière généralement plate du noyau (12).

3. Câble médical de guidage selon la revendication 1, dans lequel au moins un parmi ledit fil de sécurité et ledit fil de transition est un fil formant ruban plat.

4. Câble médical de guidage selon la revendication 1, dans lequel au moins un parmi ledit fil de sécurité, ledit fil de transition, ledit second enroulement et ledit élément arrondi sont constitués de matériaux opaques à la radiographie.

5. Câble médical de guidage selon la revendication 1, dans lequel ledit matériau opaque à la radiographie est constitué de platine.

6. Câble médical de guidage selon la revendication 1, dans lequel ledit premier enroulement (14) dans une première zone (53) précédant ledit second enroulement a un premier diamètre extérieur et, dans une seconde zone (49) distale de ladite première zone, ledit premier enroulement a un second diamètre extérieur relativement plus petit, et

ledit second enroulement (18), dans une zone proximale adjacente audit premier enroulement a un diamètre extérieur à peu près égal au premier diamètre extérieur dudit premier enroulement et un diamètre intérieur à peu près égal au second diamètre extérieur dudit premier enroulement, et la zone proximale dudit second enroulement est agencée autour de la seconde zone à diamètre plus petit dudit premier enroulement.

7. Câble de guidage selon la revendication 6, dans lequel le diamètre dudit premier enroulement (14) dans ladite première zone est pratiquement uniforme et le diamètre dudit premier

enroulement dans ladite seconde zone est pratiquement uniforme, et ladite première zone se trouve immédiatement adjacente à ladite seconde zone.

8. Câble médical de guidage selon la revendication 6, dans lequel le second diamètre relativement plus petit de la seconde zone dudit premier enroulement est formé en supprimant du matériau du fil d'enroulement à partir de l'extérieur dudit enroulement.

9. Câble médical de guidage selon la revendication 6, dans lequel ledit premier enroulement et ledit second enroulement sont reliés (en 20) dans la zone proximale dudit second enroulement.

10. Câble médical de guidage selon la revendication 1 ou 6, dans lequel les enroulements adjacents dudit premier enroulement (14) situés dans la zone proximale de liaison avec ledit second enroulement (18) sont relativement plus espacés que les enroulements adjacents d'autres zones plus proximales dudit premier enroulement.

11. Câble médical de guidage selon la revendication 1, dans lequel ledit premier enroulement se termine de manière distale (16) par rapport à l'extrémité proximale dudit noyau et ledit câble de guidage comporte en outre un manchon (42) de matériau en polymère agencé autour dudit noyau.

12. Câble médical de guidage selon la revendication 11, dans lequel le matériau dudit manchon est du polytétrafluoroéthylène (PTFE).

13. Câble médical de guidage selon la revendication 1, dans laquelle le manchon (42) se termine distalement en étant adjacent à l'extrémité proximale (16) dudit premier enroulement (14) et le diamètre extérieur dudit premier enroulement adjacent audit manchon est égal au diamètre extérieur du manchon adjacent ou plus grand que ce dernier.

14. Câble médical de guidage selon la revendication 1 comportant, en séquence, un premier enroulement (14) et un second enroulement (18) relativement plus souple,

ledit premier enroulement dans une première zone (53) précédant ledit second enroulement a un premier diamètre extérieur, dans une seconde zone (49) distale par rapport à ladite première zone ledit premier enroulement a un second diamètre extérieur relativement plus petit, et

ledit second enroulement, dans une zone proximale (49) adjacente audit premier enroulement, a un diamètre extérieur à peu près égal au premier diamètre extérieur dudit premier enroulement et un diamètre intérieur à peu près égal au second diamètre extérieur dudit premier enroulement, et la zone proximale dudit second enroulement est agencée autour de la seconde zone de diamètre plus petit dudit premier enroulement.

15. Câble médical de guidage selon la revendication 14, dans lequel le diamètre dudit premier enroulement (14) dans ladite première zone (53) est à peu près uniforme, et le diamètre dudit premier enroulement dans ladite seconde zone (49) est à peu près uniforme, et ladite première zone se trouve immédiatement adjacente à ladite seconde zone.

16. Câble médical de guidage selon la revendication 14, dans lequel le second diamètre relativement petit de la seconde zone dudit premier enroulement est formé par suppression de matériau du fil d'enroulement à partir de l'extérieur dudit enroulement.

17. Câble médical de guidage selon la revendication 14, dans lequel:

ledit premier enroulement (14) étant formé d'un fil rond, ledit premier enroulement dans une première zone précédant ledit second enroulement (18) a un premier diamètre extérieur à peu près uniforme et dans une seconde zone distale de ladite première zone ledit premier enroulement a un second diamètre extérieur à peu près uniforme relativement plus petit formé par enlèvement de matériau du fil d'enroulement à partir de l'extérieur dudit enroulement, ladite première zone étant située immédiatement adjacente à ladite seconde zone, la différence entre ledit premier diamètre extérieur et ledit second diamètre extérieur étant plus petite que la moitié du diamètre dudit fil rond ou égal à cette moitié, et

ledit second enroulement (18) dans une zone proximale adjacente audit premier enroulement, a un diamètre extérieur à peu près égal au premier diamètre extérieur dudit premier enroulement (14) et un diamètre intérieur à peu près égal au second diamètre extérieur dudit premier enroulement, et la zone proximale dudit second enroulement est agencée autour de la seconde zone de diamètre plus petit dudit premier enroulement.

18. Câble médical de guidage selon la revendication 17, dans lequel le fil dudit second enroulement est rond.

19. Câble médical de guidage selon la revendication 14 ou 17, dans lequel ledit premier enroulement et ledit second enroulement sont reliés (en 20) dans la zone proximale dudit second enroulement.

20. Câble médical de guidage selon la revendication 14 ou 17, dans lequel des enroulements adjacents dudit premier enroulement (14) dans la zone proximale de liaison avec ledit second enroulement (18) sont relativement plus écartés que les enroulements adjacents d'autres zones plus proximales dudit premier enroulement.

21. Câble médical de guidage selon la revendication 1, 6, 14 ou 17, dans lequel ledit premier enroulement (14) a une partie extérieure ayant un diamètre diminuant.

22. Câble médical de guidage selon la revendication 1, 6, 14 ou 17, dans lequel ledit second enroulement (18) a une partie extérieure de diamètre diminuant.

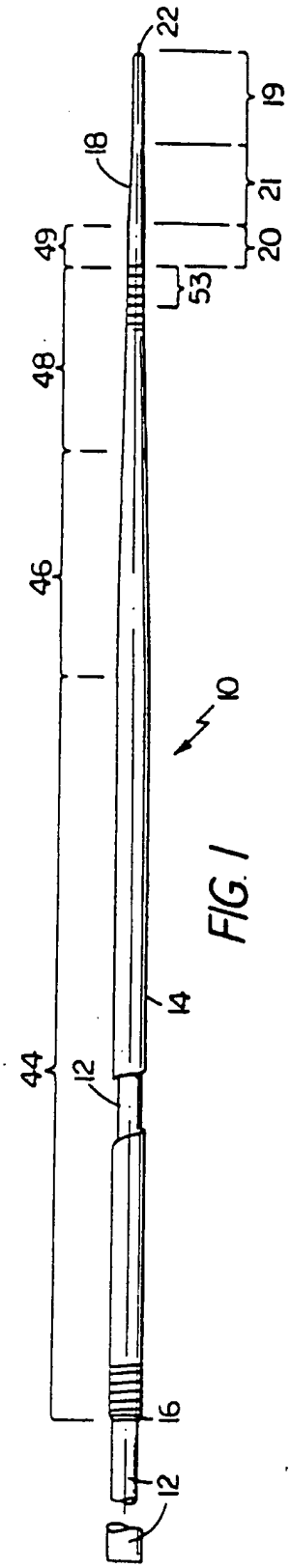

FIG. 1

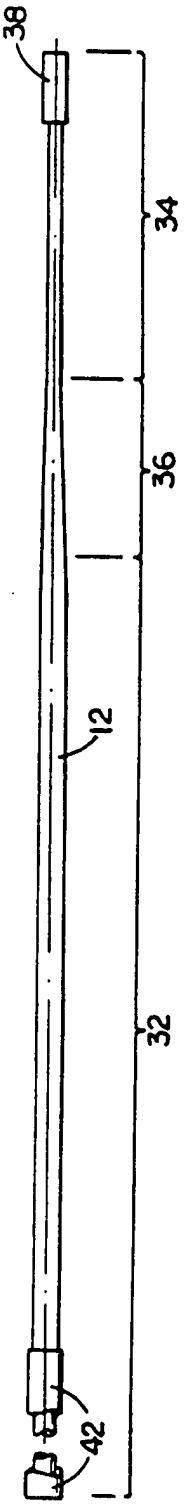

FIG. 2

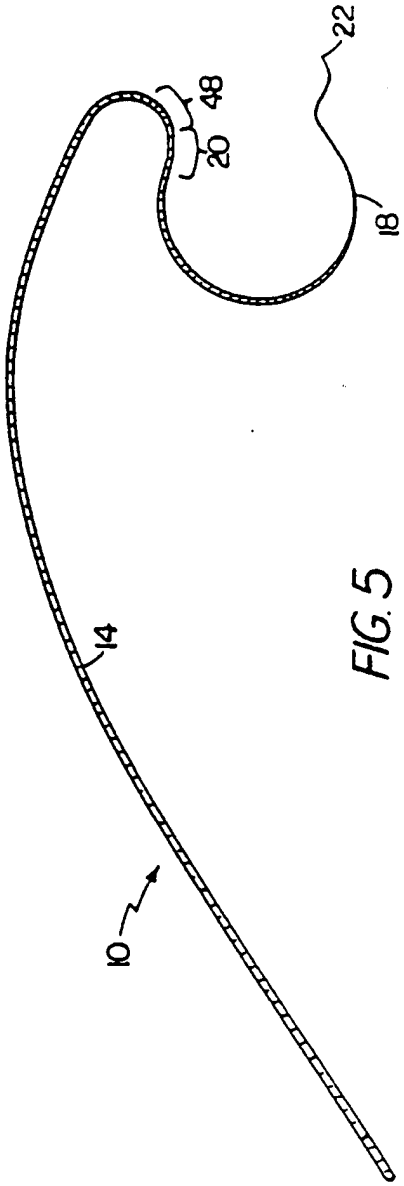

FIG. 5

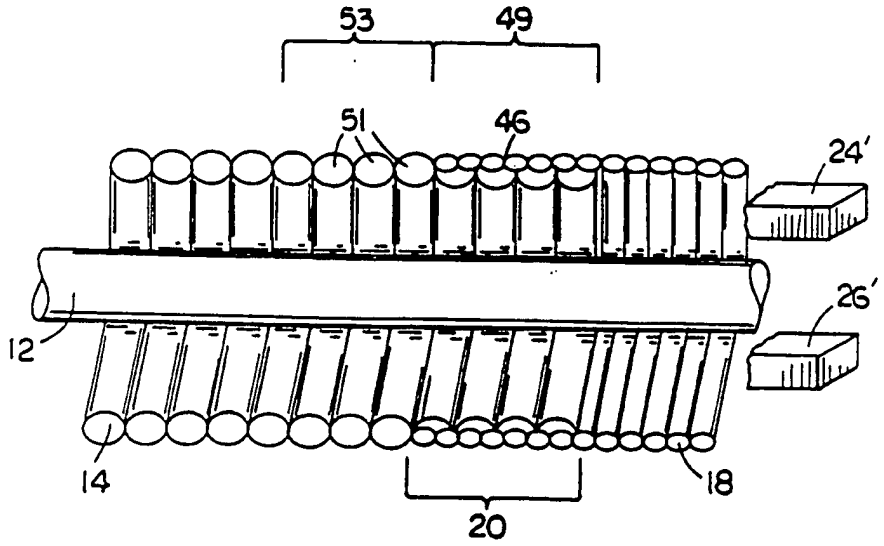

FIG. 4

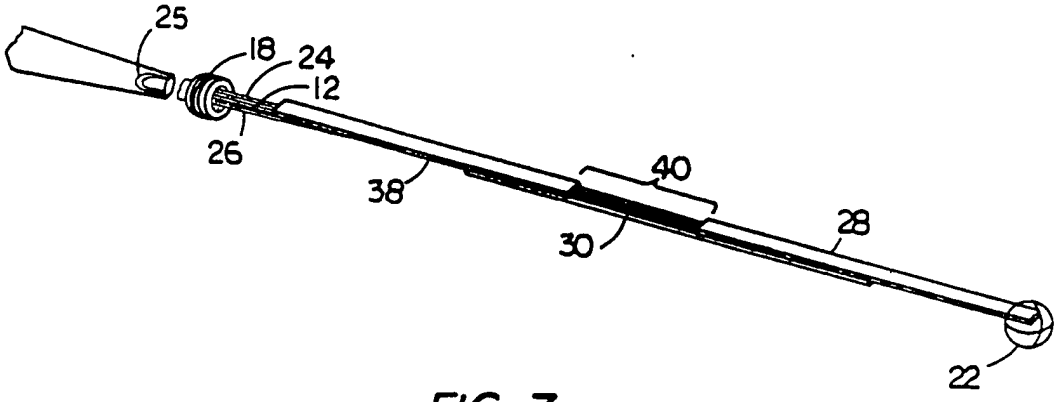

FIG. 3